

1

PROBE PIN ASSEMBLY, A METHOD OF MAKING THE SAME AND A CONNECTOR USING THE SAME

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to a connector having a probe pin assembly embedded in its insulating housing such as used in cellular phones, electric devices for domestic use or personal computers. Also, the present invention relates to a probe pin assembly for such a connector and a method of making the same.

2. Description of Related Art

Referring to FIG. 7, a conventional connector **20** has a probe pin assembly **1** embedded in its insulating housing mold **13**. The probe pin assembly **1** comprises a plurality of contact pins **11**, which are spring-biased to permit their tip ends to appear from the sleeves **6a** and the insulating housing mold **13**. In an attempt to reduce the connector size the connector uses coiled springs **12** rather than spring plates.

As seen from the drawing, each metal sleeve **6a** has a contact pin **11** slidably fitted therein, and a coiled spring **12** placed on its bottom. Thus, each contact pin **11** is so spring-biased axially that its tip end may appear from the sleeve **6a**.

Probe pin assemblies are distinguished in terms of the leg shapes formed on the rear sides of their sleeves, as for instance, follows: surface-mounting type (SMT) of probe pin assembly (see FIG. 8); DIP type of probe pin assembly (see FIG. 9); and right-angled type of probe pin assembly, which has a post **21** bent at a right angle (see FIG. 10).

Sleeves are usually made by machining, and therefore, much time and cost are involved. As seen from FIG. 11, sleeves **6a** and posts **22** are made separately, and these parts are combined together with caulking. Advantageously resultant products effectively prevent the rising of soldering material while being subjected to the dip-soldering process. Disadvantageously such structures require extra parts, and accordingly management and manufacturing costs increase.

SUMMARY OF THE INVENTION

One object of the present invention is to provide an improved probe pin assembly which is free of defects as described above.

Another object of the present invention is to provide a method of making such an improved probe pin assembly.

Still another object of the present invention is to provide a connector using such an improved probe pin assembly.

To attain these objects a probe pin assembly according to the present invention comprises: one or more sleeves which are formed by stamping and deep-drawing an elongated strip of thin metal sheet with dies; contact pins slidably fitted in the sleeves; resilient members contained in the sleeves to spring-bias the contact pins, thus allowing their tip ends to appear from the sleeves; and cover plates for closing the rear openings of the sleeves, thereby preventing the resilient members from spring out from the sleeves. The sleeves may be plated only the lower halves.

A method of making probe pin assemblies according to the present invention comprises the steps of: feeding an elongated strip of thin metal sheet to be stamped and deep-drawing sequentially, thus forming a series of sleeves, each having openings at its front and rear ends; inserting a

2

contact pin from the rear side of each sleeve to permit its tip end to appear from the front end of the sleeve; putting a resilient member behind the contact pin in each sleeve; and applying a cover plate to the rear end of each sleeve and crimping the rear part of sleeve around the cover plate, thereby closing the sleeve on its rear side.

The method may include further steps of: rolling up the series of sleeves, and continuously feeding the sleeves to plate the inner and outer walls with gold while being unrolled after the step of forming a series of sleeves.

Further, the plating may be partial-plating to be made onto the lower halves of the sleeves to save of gold for reduction of manufacturing cost.

A connector according to the present invention comprises a probe pin assembly as described above and an insulating housing mold having the probe pin assembly embedded therein.

In making probe pin assemblies according to the present invention sleeves are made by making a series of holes in an elongated strip of thin metal sheet, and by deep-drawing such holes with dies, thus facilitating the making of sleeves, not requiring much time.

Still advantageously, the stamping permits sleeves of different shapes to be provided simply by selecting appropriate dies. Sleeves whose shape cannot be formed by machining can be provided easily by stamping a thin metal sheet with dies. A variety of sleeve shapes including DIP type of sleeve shapes or right-angled type of sleeve shapes can be formed by subjecting stamped objects to another pressing or bending process. The closing of the sleeve end with a stationary cover by caulking effectively prevents the rising and invading of soldering material into the sleeve.

An elongated strip of thin metal sheet can be rolled and unrolled in stamping sleeves and covers out of the thin metal sheet. Advantageously the rolling and unrolling facilitates automatization of making and assembling parts to probe pin assemblies. The thickness of sleeve material can be significantly reduced compared with sleeves produced by machining, thus better meeting a desire for reducing the thickness of cellular phones and other electronic devices.

The deep-drawing will cause appearance of almost invisible longitudinal scars on the inner surface of the sleeve, which longitudinal scars can reduce significantly the friction with which the contact pin slides on the inner surface of the sleeve.

There is a fear of causing cracks to appear on the post of the sleeve in bending if the sleeve is formed by machining. The sleeve which is formed by deep-drawing is quite free of such cracks.

The rolling and unrolling of an elongated strip of thin metal sheet permits partial-plating of sleeves with gold.

Other objects and advantages of the present invention will be understood from the following description of a probe pin assembly according to one preferred embodiment of the present invention, which is shown in accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1A is a plane view of an elongated strip of thin metal sheet in stamping and deep-drawing the same whereas FIG. 1B is a side view of the elongated strip of thin metal sheet of FIG. 1A;

FIG. 2 illustrates how parts are assembled to a probe pin;

FIG. 3A is a longitudinal section of the probe pin whereas FIG. 3B is a bottom view of the probe pin;